IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Of:	Walter H. WHITLOCK
Serial No:	10/643,597
Filed:	19 August 2003
For:	Process and System for Cleaning Surfaces of Semiconductor Wafers
Art Unit:	1746
Examiner:	El Arini, Zeinab
BOC Case No:	M02A454

Mail Stop Appeal Brief
Commissioner for Patents
P.O. Box 1450
Washington, D.C. 22313-1450

June 13, 2006

APPEAL BRIEF

Dear Sir:

The following Appeal Brief is respectfully submitted in connection with the above identified application in response to the Advisory Action dated 12 April 2006, maintaining the rejection of claims 1-20 as set forth in the Final Office Action dated 12 January 2006.

Table of Contents

Real Party in Interest

The real party in interest for the above-identified application are the inventors, and the assignee of the invention, The BOC Group, Inc.

Related Appeals and Interferences

There are no related appeals or interferences known to any of the appellants, the undersigned or the assignee which will directly affect, be directly affected by, or have a bearing on the Board's decision in the pending appeal.

Status of Claims

Claims 1-20 are rejected and claims 1-20 are appealed.

Status of Amendments

An amendment after-final rejection was filed 30 March 2006 and has been acted upon by the Examiner. In particular, the Examiner indicated in the Advisory Action that the amendment would be entered for purposes of appeal but that claims 1-20 remained rejected over prior art. The Examiner also indicated that a rejection based on 35 USC 112, second paragraph had been overcome.

However, the amendment filed 30 March 2006 was also found by the Examiner to be non-compliant because of deficiencies in an earlier amendment to the specification. Therefore, a supplemental amendment was filed 28 April 2006 to overcome the non-compliance. No further action from the Examiner has been received to date. Therefore, it is respectfully requested that the supplemental amendment be entered for purposes of this appeal.

Summary of Claimed Subject Matter

The present invention relates to processes and systems for cleaning the surface of a semiconductor wafer. In general semiconductor wafers are cleaned using a combination of organic solvents and dense gases, such as isopropyl alcohol mixed with carbon dioxide. These cleaning mixtures must be delivered to the wafer at high pressure (1000 psia or more) because of the need to liquefy the gas component. This requires the use of high-pressure pumps that may have to be constructed of relatively expensive, corrosion-resistant materials. Such pumps are generally suitable for delivery at constant flow rates, but are less adept at delivering momentary or surge flow rates. In addition, if additives are needed, such may require a separate high-pressure pump. (Specification page 1, lines 24-34)

The present invention provides processes and systems for cleaning semiconductor wafers wherein the number of high-pressure pumps is minimized and allows for momentary or surge flow rates to be provided. In particular, independent claim 1 of the present invention provides a process for cleaning a surface of a semiconductor wafer, wherein a cleaning component selected from the group consisting of a dense gas component, a liquid component and a mixture thereof is provided to a bellows accumulator, and an elevated pressure is applied to the bellows to discharge the cleaning component onto the surface of a wafer to be cleaned. (Specification page 3, lines 19-25)

Independent claim 8 of the present invention describes another process for cleaning a surface of a semiconductor wafer, wherein multiple bellows accumulator are utilized, a first for conveying a dense gas component and a second for conveying a liquid component to the wafer surface. (Specification page 3, line 26-34)

Independent claim 11 of the present invention defines a further process for cleaning a surface of a semiconductor wafer, wherein two accumulators are used to convey a

dense gas component and a liquid component to the wafer. The accumulator for dense gas is a bellows accumulator and the elevated pressure supplied to the second accumulator is applied via the dense gas component. (Specification page 4, lines 4-13)

Independent claim 13 of the present invention provides a system for cleaning a surface of a semiconductor wafer, including a bellows accumulator adapted to receive and retain a cleaning component selected from a dense gas component, a liquid component and a mixture thereof; means to apply elevated pressure to discharge the cleaning component onto a wafer, and a chamber to receive and retain the wafer during cleaning. (Specification page 4, lines 15-21)

Independent claim 14 of the present invention describes a system for cleaning a surface of a semiconductor wafer, having two accumulators, one for each of a dense gas component and a liquid component, wherein the first accumulator is a bellows accumulator, means to apply elevated pressure to each accumulator and a chamber to retain the wafer during cleaning. (Specification page 4, lines 22-31)

Independent claim 16 of the present invention provides a process of mixing a dense gas component and a liquid component, the process comprising conveying the dense gas component to a bellows accumulator, conveying the liquid component to an accumulator, applying elevated pressure to the bellows accumulator to discharge the dense gas therefrom, applying elevated pressure to the second accumulator to discharge the liquid component therefrom, and combining the discharged dense gas component and the discharged liquid component to form a mixture. (Specification page 4, line 32 – page 5, line 7)

The present invention provides enhanced wafer cleaning performance and has the advantage of delivering dense gas and liquid to high pressures and flow rates without the use of high-pressure pumps.

Grounds of Rejection to be Reviewed

1. Whether claims 1-20 are properly rejected under 35 USC 103(a) as being unpatentable over DeYoung et al. (US 2002/0112747) in combination with Nishio (US 6,612,818).

2. Whether claims 1-2, 5, 8-19 and 20 are properly rejected under 35 USC 103(a) as being unpatentable over Barton (US 6,085,762) in combination with Nishio.

Argument

1. Whether claims 1-20 are properly rejected under 35 USC 103(a) as being unpatentable over DeYoung et al. (US 2002/0112747) in combination with Nishio (US 6,612,818).

The Examiner has rejected claims 1-20 under 35 USC 103(a) as being unpatentable over DeYoung et al. in combination with Nishio. The Examiner cites DeYoung et al. as disclosing a process and apparatus for cleaning semiconductor wafers using dense carbon dioxide. However, the Examiner recognizes that DeYoung et al. does not teach use of a bellows accumulator as defined by the present claims. Therefore, the Examiner relies on Nishio for disclosure of a bellows type pump and accumulator used to transport chemical liquid for various processes, including washing liquid crystal displays. The Examiner then concludes that it would have been obvious "to use the accumulator taught by Nishio instead of the pressure vessel taught by DeYoung et al. to obtain the claimed process and system, and to improve the cleaning process". The Examiner reaches this conclusion "because both accumulator and pressure vessel [are] used to elevate the pressure of the cleaning component". In addition, the Examiner suggests that it would have been obvious "to adjust the flow rate to obtain the component velocity as claimed", but does not cite any prior art in support thereof. These rejections are respectfully traversed and it is respectfully submitted that the present claims are patentably distinct from DeYoung et al. in combination with Nishio.

Initially it is respectfully submitted that in order to support a conclusion that a claimed combination is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed combination or the Examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teaching of the references. (See Ex parte Clapp, 227 USPQ 972; PTO Bd of APP INT, 1985.) Further, applicants

respectfully submit that obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination. (See ACS Hospital Systems, Inc. v. Montefiore Hospitals, 221 USPQ 929; Fed Cir. 1984.)

In this light, it is respectfully submitted that DeYoung et al. and Nishio clearly fail to expressly or impliedly suggest combination. Further, the Examiner has failed to provide a convincing line of reasoning that supports the combination. In particular, it is clear that neither DeYoung et al. nor Nishio expressly or impliedly suggests combination. In fact, the two references are directed to very different technologies that makes the supposed combination extremely unlikely. DeYoung et al. relates to methods of cleaning microelectronic structures, while Nishio is directed to reducing pulsation in a bellows type pump. While the Nishio pump could be used in a surface cleaning system, such fact hardly supports the combination suggested by the Examiner. In particular, the mere fact that both the DeYoung et al. and Nishio systems employ some type of pressure device falls well short of providing the necessary incentive for combination.

Further, even if the references could be combined as suggested by the Examiner, it is respectfully submitted that such combination would not render the present invention obvious. In this light, the Examiner has recognized that DeYoung et al. fails to teach or suggest the use of a bellows accumulator. It is respectfully submitted that replacing the vessel of DeYoung et al. with the bellows type pump of Nishio would actually render the DeYoung et al. apparatus and method inoperable. The cleaning process of DeYoung et al., as well as that of the present invention, requires elevated pressures for the cleaning components. Conversely, Nishio discloses use of either a bellows type pump or a bellows type accumulator employed as a pulse dampener to convey a low pressure fluid in a chemical process. The bellows type pump of Nishio is incapable of pumping fluids to high pressure for a number of reasons. Initially, excessive force would be required to move the piston rod 13 if high pressures were

present in bellows 7 of Nishio. In addition, the bellows 7 is required to be easily deformable and therefore is incapable of containing high pressure without having balancing with high pressure fluids outside of the bellows 7. Clearly, Nishio does not disclose such an arrangement. Therefore, there is simply no incentive for one skilled in the art to look to Nishio, a low pressure system, as a possible combination with DeYoung et al., a high pressure system. As noted, even if combinable, such combination would not render the present invention obvious, but would rather result in an inoperable system.

The Examiner also appears to be asserting that the adjustment of flow rate to obtain component velocity as claimed in the instant claims would be "well known" or a "matter of common knowledge" and that the particular velocities of the present claims (claims 6 and 7) would be "well known". This assertion is respectfully traversed, and it is respectfully submitted that the Examiner has failed to meet the "substantial evidence" standard (See MPEP 2144.03) that requires the facts asserted to be well-known be capable of instant and unquestionable demonstration as being well-known. It is not appropriate for the Examiner to take official notice of facts without citing a prior art reference where the facts asserted to be well known are not capable of instant and unquestionable demonstration as being well-known, as is the case here. It is clear that the specific velocities of the present claims are not well known, but rather a specific dependent limitation appropriate for the present invention. The Examiner has been asked repeatedly to provide documentary evidence supporting this allegation as required by MPEP 2144.03, but has failed to do so.

It is respectfully submitted that present claims 1-20 are patentably distinct from DeYoung et al. in combination with Nishio and it is respectfully requested that the rejection of such claims under 35 USC 103(a) be reviewed and overturned by the Board of Appeals.

2. Whether claims 1-2, 5, 8-19 and 20 are properly rejected under 35 USC 103(a) as being unpatentable over Barton (US 6,085,762) in combination with Nishio.

The Examiner has rejected claims 1-2, 5, 8-19 and 20 under 35 USC 103(a) as being unpatentable over Barton in combination with Nishio. The Examiner indicates that Barton discloses a process and system for cleaning semiconductor wafers, but notes that Barton (like DeYoung et al.) fails to teach the bellows accumulator required by the present claims. Therefore, the Examiner again relies on Nishio for teaching a bellows accumulator for the same reasons as set forth with respect to claims 1-20 and the combination with DeYoung et al. noted above. These rejections are traversed and it is respectfully submitted that the present claims are patentably distinct from Barton in combination with Nishio.

The Barton system uses three ballast tanks 36, 38, and 40 that are simple vessels periodically refilled with the dense phase fluid and fluid modifier. Such simple vessels are sufficient in Barton because there is no capability to maintain constant pressure in the process vessel of Barton. In fact, it is actually intended to be able to change the pressure in the process vessel. As noted above, Nishio relates to a low pressure system. There is again no reason why one skilled in the art would look to Nishio for combination with Barton, and clearly the Examiner has failed to meet the burden necessary for establishing such a combination. The Examiner's statements that "simply alternating choice of tank because Barton discloses that to render the process as continuously efficient as possible ..." falls well short of this burden and in fact makes little if any sense. It is completely unclear why or how the bellows pump of Nishio could be substituted for the ballast tanks of Barton and it is respectfully submitted that such substitution would at best defeat the purpose of the Barton system.

Therefore, it is respectfully submitted that present claims 1-2, 5, 8-19 and 20 are patentably distinct from Barton in combination with Nishio and it is respectfully

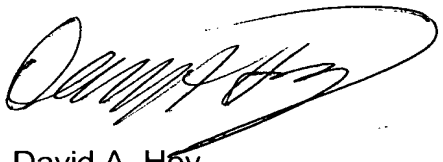
requested that the rejection of such claims under 35 USC 103(a) be reconsidered by the Board of Appeals and overturned.

Conclusion

For the reasons noted above, appellants respectfully submit that the Examiner's final rejection of claims 1-20 is not properly founded in law and, therefore, it is respectfully requested that the Board of Appeals so find and reverse the Examiner's final rejection.

A copy of the Claims on appeal, i.e., Claims 1-20, is found in the attached appendix. To the extent necessary, Appellants petition for an extension of time under 37 CFR 1.136 by separate letter.

Respectfully submitted,



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CLAIMS APPENDIX

1. A process for cleaning a surface of a semiconductor wafer, which comprises:

providing a wafer;

conveying a component selected from the group consisting of: a dense gas component, a liquid component and a mixture thereof to a bellows accumulator having a bellows therein;

applying an elevated pressure to said bellows sufficient to discharge said component from said bellows onto said surface of said wafer; and

contacting said component with said surface of said wafer to clean said wafer.

2. The process of claim 1, wherein said dense gas component is dense carbon dioxide or supercritical carbon dioxide.

3. The process of claim 2, wherein said liquid component is an organic liquid component soluble or miscible in dense carbon dioxide or supercritical carbon dioxide.

4. The process of claim 1, wherein said liquid component is selected from the group consisting of: isopropyl alcohol, hydrofluoric acid, pyridine and combinations thereof.

5. The process of claim 1, wherein said elevated pressure is applied to said bellows via a compressed gas.

6. The process of claim 1, wherein said component is a mixture and said step of contacting said component with said surface of said semiconductor wafer takes place in a pressure chamber, and further comprising the steps of:

charging said pressure chamber with said mixture to a free headspace pressure of about 1000 psia or more, and

discharging said mixture from said bellows at a flow rate sufficient to impart a mixture velocity of about 10 cm/sec or more.

7. The process of claim 1, wherein said component is a mixture and said step of contacting said component with said surface of said semiconductor wafer takes place in a pressure chamber, and further comprising the steps of:

charging said pressure chamber with said mixture to a free headspace pressure of about 2400 psia or more, and

discharging said mixture from said bellows at a flow rate sufficient to impart a mixture velocity next to the wafer surface of about 50 cm/sec or more.

8. A process for cleaning a surface of a semiconductor wafer, which comprises:

providing a wafer;

conveying a dense gas component to a first bellows accumulator having a first bellows therein;

conveying a liquid component to a second bellows accumulator having a second bellows therein;

applying an elevated pressure to said first bellows sufficient to discharge said dense gas component from said first bellows onto a surface of said wafer;

applying an elevated pressure to said second bellows sufficient to discharge said liquid component from said second bellows onto said surface of said wafer; and

contacting said dense gas component or said liquid component with said surface of said wafer to clean said wafer.

9. The process of claim 8, wherein said elevated pressure is applied to said second bellows via said dense gas component.

10. The process of claim 8, wherein said dense gas component and said liquid component are mixed prior to application to said surface of said wafer.

11. A process for cleaning a surface of a semiconductor wafer, which comprises:

providing a wafer;

conveying a dense gas component to a first accumulator wherein said first accumulator is a bellows accumulator having a first bellows therein;

conveying a liquid component to a second accumulator;

applying an elevated pressure to said first bellows sufficient to discharge said dense gas component from said first bellows onto said surface of said wafer;

applying an elevated pressure via said dense gas component to said second accumulator sufficient to discharge said liquid component from said second accumulator onto said surface of said wafer; and

contacting said dense gas component and said liquid component with said surface of said wafer to clean said wafer.

12. The process of claim 11, wherein said dense gas component and said liquid component are mixed prior to application to said surface of said wafer.

13. A system for cleaning a surface of a semiconductor wafer, which comprises:

a bellows accumulator having a bellows therein adapted to receive and retain a component selected from the group consisting of a dense gas component, a liquid component and a mixture thereof;

a means for applying an elevated pressure to said component sufficient to discharge it from said bellows onto a wafer;

a chamber adapted to receive and retain said semiconductor wafer and receive said component.

14. A system for cleaning a surface of a semiconductor wafer, which comprises:

a first accumulator wherein said first accumulator is a bellows accumulator having a bellows therein adapted to receive and retain a dense gas component;

a means for applying an elevated pressure to said dense gas component sufficient to discharge it from said bellows onto a wafer;

a second accumulator adapted to receive and retain a liquid component;

a means for applying an elevated pressure to said liquid component sufficient to discharge it from the second accumulator onto said wafer;

a chamber adapted to receive and retain said semiconductor wafer and receive said dense gas component and said liquid component.

15. The system of claim 14, further comprising a means adapted to receive and mix said dense gas component and said liquid component prior to said chamber.

16. A process for mixing a dense gas component and a liquid component, which comprises:

conveying a dense gas component to a first accumulator wherein said first accumulator is a bellows accumulator having a first bellows therein;

conveying a liquid component to a second accumulator;

applying an elevated pressure to said first bellows sufficient to discharge said dense gas component from said first bellows;

applying an elevated pressure to said second accumulator sufficient to discharge said liquid component from said second accumulator; and

combining the discharged dense gas component and the discharged liquid component to form a mixture.

17. The process of claim 16, wherein the second accumulator is a second bellows accumulator.

18. The process of claim 16, wherein said dense gas component is dense carbon dioxide or supercritical carbon dioxide.

19. The process of claim 16, wherein said liquid component is an organic liquid component soluble or miscible in dense carbon dioxide or supercritical carbon dioxide.

20. The process according to claim 16, wherein said liquid component is selected from the group consisting of: isopropyl alcohol, hydrofluoric acid, pyridine and combinations thereof.

EVIDENCE APPENDIX

Not Applicable

RELATED PROCEEDINGS APPENDIX

Not Applicable